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Technical Communication No. 8

Nutrition Research in the British Colonial Empire

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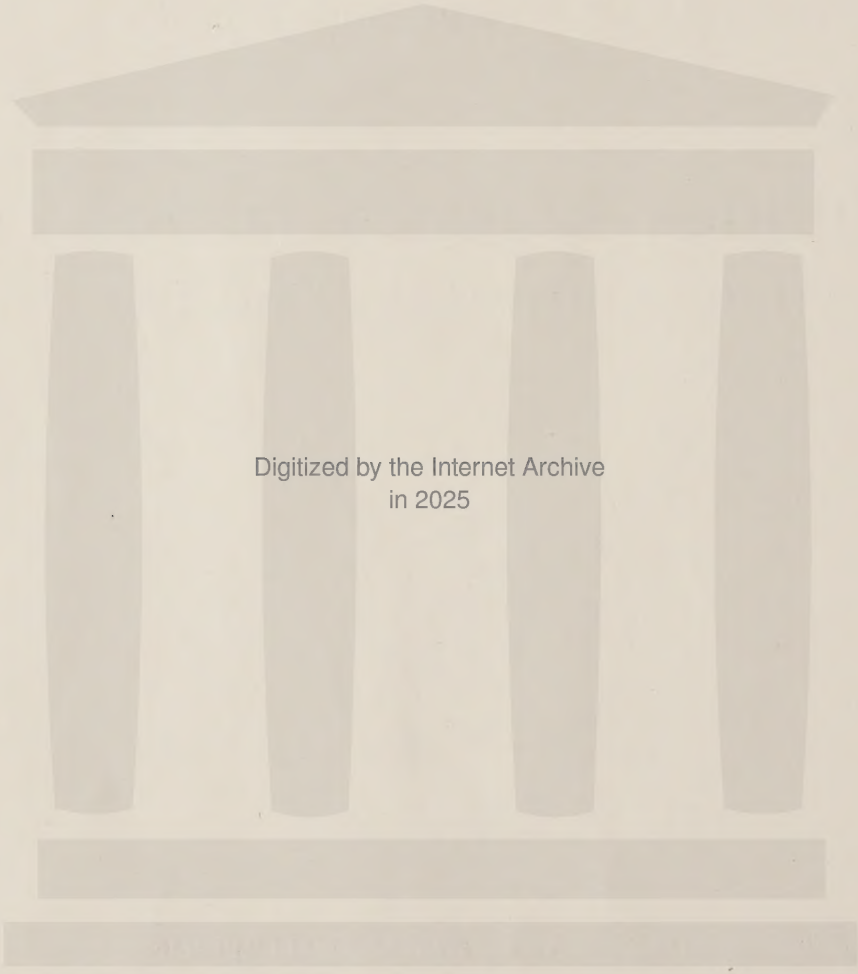

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NUTRITION RESEARCH IN THE BRITISH COLONIAL EMPIRE.

INTRODUCTION.

In this Communication an endeavour has been made to review the principal results of recent investigations on the state of nutrition and the dietary conditions of natives inhabiting the countries which comprise the British Colonial Empire.

The survey covers the years 1926–1936, a period of intense universal interest in the subject of nutrition, and during which much important research was initiated and carried through in certain of our Colonies.

No attempt has been made to deal exhaustively with the literature on the subject, although it is believed that all the most important and informative sources of information are cited. The aim has been rather to present a general picture of the situation as it applies to each country in the Colonial Empire for which data are available in the Imperial Bureau of Animal Nutrition.

The countries are grouped alphabetically according to the undernoted geographical key, and, for the most part, the particulars given deal with the existing dietary conditions in relation to the health of the native. Where special nutritional investigations have been undertaken, these are given fuller treatment, mention being made of the facilities available for research and the principal workers engaged thereon.

Many valuable results have accrued from studies made on the nutritional conditions of natives in the Union of South Africa. In view of their importance and bearing on similar problems existing in other parts of Africa, an appendix is included which treats specially with the South African work on the subject.

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I. AFRICA.

Basutoland.

No special nutritional investigations appear to have been carried out in Basutoland. The Chief Medical Officer reports (1) that 76 cases of pellagra were notified in 1934, as compared with 3 cases in 1933. This would indicate that the disease is on the increase. Pellagra is a disease characteristic of maize-eating tribes and is associated with vitamin B deficiency.

Conditions in Basutoland are probably similar to those in the neighbouring territories of the Union of South Africa, information on which will be found in the section dealing with that part of Africa.

Bechuanaland.

Recent reports from the Medical Department (2, 3) emphasise the poor physique of the Bechuana and attribute this to inadequate food. Maize porridge is the staple diet, except in the summer when milk and vegetables are available. The average weight of 500 adult males examined as to fitness for work in gold mines was only 8 st. 13 lb. Thirty-three per cent. were rejected as unfit. Bechuana adolescents are 20 per cent. below corresponding European weight standards. Vitamin deficiency is considerable, and the susceptibility to malaria is high, due to improper nourishment. Beyond the valuable observations of Medical Officers, no official research is in progress so far as is known. The Section on South Africa should also be consulted in relation to Bechuanaland conditions.

Gambia.

The native dietary is excessively high in carbohydrate and deficient in fats and proteins. This is given as the reason for the prevalence of gastric complaints (4). Information on native nutrition is available from time to time in the Annual Reports of the Medical Department, but no large-scale dietetic surveys or researches have been undertaken.

Gold Coast.

Official reports of medical authorities in the Gold Coast, while indicating that deficiency diseases are relatively uncommon, point to monotony and dietary imbalance as a factor lowering health and resistance to disease, children being the chief sufferers (5, 6, 7). Respiratory disease is the main cause of registered deaths, a circumstance indicating some degree of vitamin A deficiency. Dental caries is rare, but the condition of the gums is often unsatisfactory.

The health conditions among itinerant labourers provides an instructive example of the value of regular dietary habits. When moving from place to place in search of work they rely on uncertain supplies of kola nuts. Parasitic infestation is rife and the incidence of tuberculosis very high. On securing regular work and food, however, the physical condition of the labourers improves to an astonishing extent (6).

According to Purcell (8) rickets is practically unknown in the Gold Coast, only isolated cases being encountered. Williams (9) and Stannus (10) describe a nutritional disease of childhood associated with a maize diet. The condition which in some respects simulates pellagra occurs in children breast fed by foster mothers whose milk supply is inadequate and has to be supplemented by soured preparations of maize. Curative measures are found in a full diet of tinned milk, cod liver oil, eggs and fruit. The dietary habits of one Gold Coast tribe, namely the Tallensi, were specially examined by Fortes and Fortes (11). Otherwise no detailed surveys seem to have been undertaken. The food of the Tallensi consists of millet, guinea corn, nuts, beans, root vegetables and certain fruits. The tribe are however improvident, neglecting to store food against times of scarcity. Hunger consequently results at seasons of low agricultural output. An informative pamphlet on Gold Coast food has been compiled by Field (12). Peppers, obtainable everywhere in the Gold Coast, are a popular article of diet, even among very young children. They provide a good source of vitamin C (6).

Kenya.

In no other part of the British Colonial Empire has more nutritional research been done than in Kenya Colony. The first native dietary surveys were initiated towards the end of 1925 by the Dietetics Committee of the Committee of Civil Research (now the Economic Advisory

Council) and were partly financed by the Empire Marketing Board. Several specially trained research workers were sent to Kenya from the Rowett Institute, Aberdeen, to work in collaboration with the Kenya Medical Department, and it was only due to this successful co-operation that efficient work was made possible. The procedure adopted in Kenya whereby local representatives worked in association with others from a Research Institute at home might well be taken as a model for similar investigations which may be contemplated elsewhere in the Colonies. The results of these investigations, which will be briefly referred to below, were embodied in a series of joint papers published between 1925 and 1931 by Orr, Henderson and Foster of the Rowett Institute and Gilks, Kelly, Callanan and Harvey of the Kenya Service (13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23). The interest in native nutrition aroused by these surveys stimulated other Government Medical Officers and private members of the local branch of the British Medical Association to enquire into conditions in their own areas and to contribute their findings to the scientific press. Hence, in addition to the publications of Orr and Gilks and their associates, we find contemporary papers on various aspects of Kenya nutrition appearing under the names of Carman, Plum, Price, Wilson, Maplestone, McNabb, Procter, Gordon, Jex-Blake and Gillan (24, 25, 26, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37).

The Kenya investigations may be roughly grouped in four categories:

(1) Field surveys in the Reserves to determine what the native eats and the state of his physique.

(2) Laboratory studies to determine the composition of native foodstuffs.

(3) Studies on the relation between diet and disease carried out in Institutions such as Hospitals, Prisons, Labour Corps, etc., where the diet is on a fixed scale and where conditions can be controlled to permit of metabolic work being done on selected subjects.

(4) Observations on specific deficiency disease conditions encountered by Medical Officers in the course of their day to day work.

Field surveys.—The most comprehensive of these is that by Orr and Gilks (14) relating to the physique and health of two contrasted tribes, Masai and Akikuyu, which, although inhabiting adjoining

territories, have entirely different dietary habits. The diet of the Masai tribe consists of meat, blood and milk, whilst that of the Kikuyu tribe is mainly composed of cereals, tubers and legumes, with practically no meat or milk. Medical examination proved beyond dispute the great superiority in weight, stature, and fitness of the milk nourished and carnivorous Masai to the vegetarian Kikuyu. The full-grown male Masai is, on the average, 5 inches taller, 23 lbs. heavier, and with muscular strength some 50 per cent. greater than the full-grown male Kikuyu. In point of physical condition Kikuyu men were on a level with Masai women. An interesting observation was the marked superiority of the Kikuyu women to the men, this being correlated with the greater amount of green leaves and edible earths consumed by the women. The Kikuyu diet was as a whole found to be deficient in calcium and sodium, elements which, in the case of the women, were made good by the eating of leaves rich in these minerals. Two edible earths popular with pregnant women were found to have a high iron content. The higher mineral intake of the women seems to have a direct bearing on their superior health.

Marked differences were also noticed in the incidence of disease in the two tribes. The diseases common among the vegetarian Kikuyu were bony deformities, dental caries, anæmia, various pulmonary conditions and tropical ulcer. The diseases of the Masai were of a different type, rheumatoid arthritis being common and possibly related to their high meat consumption.

The foodstuffs and dietary habits of the Luo tribes have been described by Callanan (23) and by Carman and Roberts (24). Their staple article of diet is " kuon," a doughy substance prepared by boiling " mtama " flour with water. Plum (25) writes of conditions in the Digo and Embu districts of Kenya and states that in the former where the diet consists mainly of mohogo and fish and is low in iron, anæmia is frequent. In the Embu district, on the other hand, green vegetables and meat are eaten, with the result that anæmia is less prevalent. It is held that ankylostomiasis is the primary cause of the anæmia, but that iron poor diets favour its development. Dental caries among African tribes in relation to their diet has been considered by Price (26). His data which apply to Kenya, Uganda and the Belgian Congo, indicate a high immunity to caries among tribes living on the best native foods. The incidence became greater with the approach to more civilised conditions *via* the Nile to Khartoum and Cairo.

Composition of native foodstuffs.—Chemical analyses of the foodstuffs collected during the Masai-Kikuyu survey were carried out at the Rowett Institute, Aberdeen, the samples having first been prepared for despatch at the Medical Laboratory in Nairobi. It is now possible, however, to undertake these analyses on the spot in the new and well-equipped Laboratories at Nairobi where Dr. Harvey is still carrying on nutritional work. These chemical studies form a necessary complement to the field surveys and the data accruing therefrom are available in a number of publications (14, 15, 27).

Institutional dietaries.—Considerable attention has been given to ensure that natives in Hospitals, Prisons and Labour Corps are provided with an adequate daily diet. The experiences of the Carrier Corps during the East African campaign of 1914–1918 are an object lesson in this connection. Prior to 1917, the year in which a satisfactory ration was attained, the mortality reached the appalling figure of 900 deaths weekly out of a total force of 110,000 men. Other factors besides diet were doubtless in operation, but those qualified to speak affirm that the gross inadequacy of the diet was the chief cause of this enormous death-rate (28). Kelly and Henderson (15) analysed the diets laid down for use in the Native Hospital and Prison, Nairobi, and found the principal fault to be qualitative, namely, a relative deficiency in vitamins, particularly fat-soluble vitamins, and in calcium. Later, these authors (16, 17, 18) supplemented the institutional dietaries and studied the effects thereof, with particular reference to the absorption and retention of calcium. Marked improvement followed the addition of calcium in soluble form. Observations on growing boys were also made. A group receiving supplementary milk gave the best results both as regards increase in body weight and retention of calcium. Harvey (19, 20, 21) continued these studies, and, one experiment in which he gave a 20 per cent. addition of wheat flour to maize meal in the prison diet, resulted in increases in weight per week of 0·97 lb. in the wheat group against 0·56 lb. for the controls.

Instructive data have also been obtained by Maplestone (30) and McNabb (31) from studies on native labour employed by the Soda Company at Lake Magadi. On the regular diet supplied, the labourers improve enormously in weight, physique and vigour, which confirms how poor must be the normal diet of the native in his Reserve. Procter's observations (32) also are similar. The diet of the natives employed on the Kisumu-Yala railway construction received special attention, and to this he attributes the low sickness and death-rates encountered.

Specific deficiency disease conditions.—Despite the improvements made in institutional diets, and the care taken to ensure that these are adequate, sporadic cases of deficiency disease still occur. Thus, Carman (33) records a case of Rand scurvy at the Nairobi gaol occurring in a prisoner of the Nandi tribe. As the Nandi and Masai, two tribes of similar dietary habits, seem peculiarly liable to Rand scurvy, it is thought that some unknown factor must operate which renders certain groups of individuals particularly susceptible to this disease. Xerophthalmia and extensive skin eruptions among patients in Mathari mental hospital have been encountered by Gordon (34), who is of the opinion that vitamin deficiency is responsible for lowering the protective power of the skin against such infections. Other conditions which have occupied the attention of medical authorities are rickets, which is unduly common in the white population in Kenya (35), and œdema, which occasionally occurs among Kikuyu children and adults (36, 37).

Dietetic problems in Kenya (and East Africa generally) have been well summarised by Gilks (38) who concludes that until further information is available the precise degree to which Kenya dietaries are deficient will remain uncertain. The incidence of night blindness and xerophthalmia among prisoners and of pneumonia, tuberculosis and ulcers suggests a general vitamin A deficiency. There is probably no deficiency of vitamin D. Bony lesions and dental caries are much more prevalent in Kikuyu than in Masai children, who consume large quantities of milk. Other observations suggest a possible iron deficiency. It is interesting to note in a recent report from the Department of Agriculture (39) that apparently increasing numbers of natives are now including meat in their diet.

Nigeria.

Coincident with the work in Kenya, investigations of a similar nature were begun in Nigeria under the auspices of the Medical Department. The chief officers concerned were McCulloch and Turner (both of whom spent periods of study at the Rowett Research Institute) and Fitzgerald-Moore. In addition, Dr. A. Clark was seconded to Nigeria for dietetic work by arrangement with the Medical Research Council and the Colonial Office. A draft of Clark's most recent report has been seen by the Imperial Bureau of Animal Nutrition, but the findings are not yet published.

McCulloch's (41, 42, 50) inquiries into the dietaries of the Hausas and Town Fulani of Northern Nigeria revealed that, although a great variety of food is grown and used by the people, the vast majority live on a porridge made from millet seed, adulterated sour milk, and a soup composed very largely from leaves of the baobab (kuka) tree, which analysis proved to have an unusually high calcium content (48). As in Kenya, edible earths and native salts are extensively used. In the southern parts of Nigeria the cereal diet of the north is replaced by yams, cassava and beans, and is seriously lacking in protein owing to the scarcity and dearness of meat (48).

The composition of local foodstuffs was determined in the Government Nutritional Laboratory at Katsina, as well as at the Rowett Institute, where a number of edible earths and native salts were also analysed (46, 50). From the data thus obtained, and from experiments on rats fed with typical native foods, it is clear that, broadly speaking, the native diets are lacking in protein, minerals and vitamins. This is reflected in the state of physique and health of certain sections of the community.

Among the Hausas the birth-rate is low, a circumstance which McCulloch (41) suggests is due to a general vitamin E deficiency. Ulcers are common, and are considered to be conditioned by a widespread chronic semi-starvation, calcium deficiency being the factor specially concerned (43). In native schools diet has received special attention (45). Retrobulbar neuritis, together with sore tongue and mouth, occurs among school children whose diet, consisting mainly of cassava, is seriously deficient in protein and vitamin B (49). Diets in Kaduna and Katsina prisons have also been improved, new scales being introduced in consequence of the high sickness and death-rate resulting from imbalance and deficiencies of minerals and vitamins A and B in the diets previously used (51).

Since McCulloch left Nigeria, his work has been continued and extended by Turner, who has paid special attention to the physical condition of school children in relation to their diet (47). His examinations in the Katsina area show that 50 per cent. of pupils were under normal standard in respect of nutrition and physique. In contrast to this only 20 per cent. of children from the Plateau pagan tribes were subnormal, a fact attributed solely to diet, inasmuch as the pagan tribes have little scruple as to their source of protein and make considerable use of benniseed which is rich in fat, protein and mineral constituents (44). Cases of goitre are met with occasionally (52), and

thyroid enlargement is frequent among women in certain districts. Iodine deficiency may be responsible. It is well known that tribes living on the banks of rivers and on the sea coast where fish is available have excellent health and fine physique.

Northern Rhodesia.

The fullest information available from Northern Rhodesia is that gained from the survey by Richards and Widdowson (53). This study provides another instance of the value of co-operative research. The field work was undertaken by Richards, with the aid of a Fellowship from the Rockefeller Foundation while Widdowson, working in the Biochemical Department of King's College Hospital, London, with a grant from the Medical Research Council, analysed the samples of foodstuffs sent home. The results of the study were published by the International Institute of African Languages and Cultures on whose Dietetic Committee Dr. Richards serves as a member.

The people selected for study were the Bemba, a millet-eating Bantu tribe unchanged by white influence, inhabiting the Tanganyika plateau of N.E. Rhodesia. Detailed observations were made of the dietary customs in the tribe, and very careful records were kept of food consumption and cooking practices among families in three typical millet-eating villages. Chemical analysis showed that, compared with European standards, the calorie value of the diet was little more than half; there was a marked deficiency of fat and of animal protein which might even be entirely absent. Vitamins A and B were well represented; vitamin C was variable, and vitamin D apparently wholly lacking. A noteworthy feature was the calcium intake. The type of millet used (finger millet) contained 0·320 per cent. of calcium, which resulted in an intake of more than double that in an average European diet. Some consideration was given to the health and physique, but as the investigator had no medical training she was unable to estimate the effect of the diet on native health. In general, the Bemba are tall, muscular, and of good physique. They could never be described as fat, however, and have almost invariably thin legs and knock knees. The weights of 30 children were taken and found to be, on an average, 8 lb. less than English children of the same age. The diseases most prevalent were fever, pulmonary affections and ulcers on the lower parts of the legs.

Conditions in the millet-eating villages were compared with those

in a typical cassava and fish-eating village situated in the territory of the Bisa. The diet in this village proved to contain much more protein, especially animal protein, and rather more fat than the diets eaten by the Bemba. It is the presence of fish in the dietary which makes this difference. As regards the staple carbohydrate food itself, however, cassava is much inferior to millet. Millet was found to contain 5–6 times as much protein, fat, calcium and phosphorus as cassava and twice as much iron. Hence, so far as their carbohydrate food is concerned, the millet-eating tribes had a distinct advantage over cassava-eating ones. In respect of physique and stamina the Bisa appeared to be smaller, stockier, more inclined to be fat, and were more energetic and better able to concentrate than the Bemba in the millet-eating villages with poor animal protein supply. The dietary conditions in the two tribes differed in another important respect. Whereas in the Bisa the supply of foodstuffs was more or less constant, varied and plentiful throughout the year, the Bemba diet was monotonous and subject to marked seasonal fluctuations, both as regards quantity and variety.

Other observations from Northern Rhodesia are those of Dry (54), who records the occurrence of scurvy in 60 per cent. of a large group of labourers there. The deficiency was caused by the native habit of discarding or overcooking vitamin-rich foods, green vegetables, meat and beans, contained in the rations. Other indications of vitamin deficiency noted were hemeralopia, œdema, leg sores, pain in the limbs and a high incidence of parasitic infection.

Nyasaland.

No special dietetic investigations appear to have been carried out in Nyasaland. Observations of Medical Officers are, however, recorded in the Annual Reports of the Medical Department from which the following notes are taken. The dietary of the natives seems to be very similar to that in the other parts of Africa already discussed. The consumption of carbohydrates, mainly as maize and cassava, is excessive. Beans form the chief source of protein and, for the majority, meat and fish are luxuries. Fruits are utilised where available, but their cultivation is not specially encouraged. Although no gross food shortage occurs, there is evidence that a proportion of the native population is on the verge of deficiency disease (57). In the Fort Johnston district native diet is thought to be deficient in vitamin C.

Children admitted to hospital on account of catarrhal conditions have been cured by a dietary addition of tomatoes. Investigations have been proposed in order to determine whether the seasonal incidence of catarrh coincides with the time of year when little vitamin C is available (56).

The question of pellagra in Nyasaland offers some features of interest. Outbreaks seem to be confined to the prisons, and though it is occasionally seen in individuals of the general native population, it is by no means common. The majority of cases reported have occurred in the Central Prison, Zomba, and despite the improvements which periodically have been made in the dietary, there is no certainty that outbreaks will not take place. During the years 1910–1913 the place of maize in the prison diet was taken by rice, and 131 cases were reported. In 1914 the diet was improved and only 12 cases occurred. In 1920, following further revision of the diet, no cases were seen; but in each of the years 1922 and 1923, 41 cases were noted among prisoners receiving the 1920 diet. The diet was again modified in 1924, and yet 137 cases with four deaths were reported, whereas in 1933 only 1 case was recorded, although the same dietary scales were used. Overcrowding in the prison seems to favour the propagation of the disease. Various therapeutic measures, dietary and otherwise, have been employed to find a suitable remedy, but with the exception of thyroid treatment the condition was uninfluenced by any of the measures adopted. Thyroid medication occasionally produced amazing improvement in certain patients, but was not invariably successful. Shelley (55), who writes of these conditions, suggests that the disease as seen in the Zomba Prison is due to the effect of some "low grade intoxication either microbic or chemical in origin," rather than to a nutritional deficiency.

Seychelles.

The food conditions, both in the main and outlying islands, have been described in recent reports from the Medical Department (59, 60). Polished rice is the staple food of the natives in the main island. In the outlying islands only unpolished rice is used. In spite of this beriberi still occurs there. Dental inspection of school children revealed that those living in country districts had a much higher percentage of sound teeth than those attending town schools. This feature is ascribed to the fact that country children lead a healthier life and have access

to more fruit and vegetables. Soundness of gums and teeth goes hand-in-hand with the practice of cleaning the teeth with salt.

Sierra Leone.

Although no planned research is in progress, several interesting accounts of deficiency diseases found in Sierra Leone are available in the published literature. Blacklock (61) describes the manifestations of rickets seen in very young children at a Mission Hospital clinic. The position appears to be that breast-fed infants under 9 months show no signs of rickets while non-breast-fed children of the same age do. Those between 9 months and 2 years who are still being breast-fed, or are undergoing dietary transition to starchy foods, such as rice or cassava, very often become flabby, and show symptoms suggestive of rickets. Children of 2 years and over who are accustomed to a more varied diet and to playing outdoors in the sunlight seldom develop rickets. In a report on congenital rickets in Sierra Leone, Wright (62) indicates that the disease is fairly common among young children, although serious disabilities in older children are rare. In this writer's view, the prevalence of rickets can be explained partly by the deficiency in native food of fat-soluble vitamins and partly by the racial pigmentation of the skin which prevents the formation of the antirachitic vitamin in response to solar irradiation.

Observations made by Wright (63, 64) in Freetown, where the staple food of the inhabitants is rice and cassava, disclose the frequency of vitamin deficiency among the people of the district. He has provided an account of the symptoms of avitaminosis A and B encountered in an antenatal clinic, in maternity and female hospital wards, and in the course of private practice. Palm oil and dried fish are commonly consumed, but neither of these can compensate for the vitamin deficiency in the staple cereals. The manifestations of the deficiency are a glazed and tremulous tongue, a sore mouth, and affected eyes, the lids often being devoid of eyelashes and gummed down by discharge. The complex of symptoms is ascribed to a dietary lack of both vitamins A and B as patients readily respond to treatment with cod liver oil and marmite. Though this avitaminosis is common in pregnant and nursing mothers, it is not solely confined to the female sex. School children also suffer from similar dietary defects.

An analogous problem confronting public health authorities in Sierra Leone is that of œdema, which has been extensively reported

upon by Burnett (65). He gives a detailed description of outbreaks occurring at Freetown in 1931–1932, in a barracks, an asylum and a prison. The disease, which has been known for over 50 years in the prison, was at first thought to be the wet form of beriberi ; but, as the improvement of the institutional diet, to include yeast, cod liver oil, fresh vegetables and fruit, did not prevent further outbreaks, the diagnosis of beriberi was discarded. The condition is akin to the endemic dropsy found in India and is now attributed to the eating of unwholesome and deteriorated rice. Cures are obtained only when the faulty rice is replaced by a fresh and uncontaminated supply.

Somaliland.

The staple articles of food of the Somaliland natives are rice, dates and ghee. Supplementary to these are the animal products, milk, mutton and camel flesh. Fruit is very scarce ; although a certain amount is obtainable from Aden, an import duty prevents extensive purchase. These facts are elicited from the Annual Medical Report for 1932 (66). In the 1935 report (67) it is stated that during good seasons abundance of milk is available in the interior and that the natives are beginning to appreciate the value of green vegetables. That this desirable dietary introduction must be of very recent date is evident from the findings of Buchanan (68) who, writing in 1932 of conditions seen by him about that time, states that there was a complete absence of fresh vegetable foods in the Somali diet. Buchanan's studies specially refer to the disease known as " Chachaleh," a condition simulating beriberi and commonly met with in British Somaliland both in township and jungle. The chief symptoms of this disease are generalised aches in the muscles, bones and joints, epigastric pain, œdema, and " burning feet." The jungle diet is rich in protein and fat, derived from camel's milk and ghee ; the township diet contains ghee and some meat, but no milk, and is therefore rather poor in protein but well supplied with fat. Rice, not very highly milled, judging by its phosphorus content, is the cereal mostly used. The onset of " Chachaleh " frequently coincides with the end of the dry season when meat and milk are scarcer than usual. The absence of fresh green vegetables from the diet may also have a part to play.

It has been reported (67) that in the Nogal Valley there is no sign of undernutrition, deficiency diseases being unknown. It would be interesting to know more regarding the precise nutritional quality of the diet in this area.

Swaziland.

The staple article of diet among the Swazis is maize, either green or matured. The grains are sometimes roasted and eaten whole, but by far the commonest practice is consumption in the form of porridge. The diet is supplemented by sour milk, pumpkins, sweet potatoes, beans and very occasionally by meat. It is ill-balanced and monotonous, being too high in carbohydrate, too low in protein and deficient in vitamins. Hitherto a redeeming feature in the dietary conditions was the amount of milk consumed, especially by children, either in the natural form or as amazi (sour milk). Unfortunately this habit seems to be discontinuing in favour of sending milk to the creamery for butter manufacture.

That the nature of the diet has an influence on native health in Swaziland is borne out by the following facts taken from recent Medical Department Reports emanating from that country (69, 70, 71). The most serious factors in the causation of tuberculosis appear to be housing and diet. The rapid recovery of early cases of joint and gland tuberculosis under conditions of good feeding in hospital proves this. In the Southern District the children are anæmic, poorly nourished and suffer from recurrent attacks of malaria. Dental caries is found in at least 50 per cent. of school children in that district. Gastro-enteritis, due to improper food, is common. Vitamin C deficiency is prevalent, as is revealed by the frequency of abscesses which are curable by orange or tomato juice. Pellagra also occurs, but not to any serious degree. No detailed dietary survey or extensive research has been carried out in this Territory.

Tanganyika.

Although no nutritional research work has been undertaken in Tanganyika on a scale comparable, for instance, with that done in the neighbouring colony of Kenya, considerable activity has been evinced by the Medical and other Departments in collecting data on the subject. Recently, Dr. J. H. McDonald of the Colonial Medical Service spent a period of study at the Rowett Research Institute with a view to prosecuting more intensive investigations on his return to the Territory. The dietary conditions are very similar to those found in Kenya. Minor degrees of malnutrition are widespread, the principal manifestations being scurvy, beriberi and a disorder resembling rickets (72). Data on the composition of local native foodstuffs have been compiled

by the Department of Veterinary Science and Animal Husbandry (73), work largely due to the initiative of French, who has carried out some important animal nutrition experiments in the Territory. Maize is the staple foodstuff, its preparation in the form of flour having been described by Scott (74). Harkness (75) has specially studied the disorders which are seen among the natives of the Bukoba District and are believed to be of nutritional origin. The diet there consisted mainly of bananas, coffee, ground nuts, beans in small quantity and sweet potatoes. Fish, meat and milk were rarely taken. Night blindness, indicating vitamin A deficiency, was common. Chronic enlargement of the parotid glands was also observed ; and the population was prone to severe respiratory infections. A condition resembling pellagra which, if not too far advanced, improved on a good hospital diet, was also frequently encountered. It is noteworthy that the occurrence of crime in the district showed a seasonal periodicity which, it is thought, might be associated with mental storms and dementia due to pellagra. Buchanan and Sanderson (76) have investigated the treatment of ulcers in African natives in Tanganyika. Although a diet rich in iron and vitamins improved the physique of the patients, it did not have any apparent effect on the rate of healing of these sores.

The question of food and economic resources in relation to the morbidity and mortality from malaria is of exceptional importance in the Colonial Empire, and, so far as Tanganyika is concerned, has been dealt with to some extent by the Colonial Development Fund Malarial Research Scheme in their Report of the Malaria Unit, Tanga (77).

Uganda.

Much important nutritional work has been done in Uganda during recent years, and a series of interesting papers bearing on local problems has been published by Officers in the Medical Department. This interest is not likely to wane in view of the transference to Uganda, as Director of Medical Services, of Dr. W. H. Kauntze, who was actively concerned with the Kenya investigations referred to above. Observations have been made along three main lines : (1) vitamin deficiencies in Uganda Prisons, a subject on which there is a considerable literature, (2) the ulcer syndrome in Uganda, and (3) vitamin A deficiency among the population of Teso.

Vitamin deficiency in Prisons.—The following is a brief summary of the combined studies of Boase (78), Perryman (79), Owen and Hennessey (80, 81, 83), Mitchell (82), and Loewenthal (84, 85). During a period of rapid enlargement and transition in the Central Prison, Kampala, diets which proved to be deficient were unfortunately provided for the prisoners. Prior to 1925 the official ration was composed of sweet potatoes or green plantains, ground nuts, beans or rice, and salt. Disease suggesting multiple dietary deficiency appeared, œdema being a prominent symptom. Following the substitution of maize for potatoes, œdema disappeared, but pellagra and xerophthalmia became prevalent. Later, lean meat, germinated beans and fresh vegetables were added to the diet. Pellagra disappeared, but xerophthalmia and a dermatosis, also ascribed to vitamin A deficiency, persisted.

The xerophthalmia and keratomalacia seen in prisons in Uganda are often associated with night blindness, another well-known manifestation of vitamin A deficiency. This gross avitaminosis-A is not as a rule so frequent in the free adult population as among individuals in confinement. Administration of cod liver oil produced rapid improvement in prisoners affected with keratomalacia, even in the most severe cases. There is evidence that, in subjects showing the severe ocular disorganisation characteristic of keratomalacia, the liver becomes damaged, thus preventing the normal utilisation of vitamin A contained in the food. The condition is akin to that found under similar circumstances in Sierra Leone and already referred to in our notes on that country.

The ulcer syndrome in Uganda.—Loewenthal (86, 87), who has specially studied this problem, is in agreement with McCulloch (43) that tropical ulcer is of dietetic and not of bacterial origin. Loewenthal's enquiry into the dietary of a large number of ulcer cases revealed the fact that foods deficient in calcium and fat formed the staple diet. Ulcers are of less common occurrence where the diet is richer in calcium and fat, and are scarcely ever met with among native chiefs and house-boys whose circumstances permit of their obtaining a regular and adequate diet including meat and milk. Uniformly successful results have been obtained by Loewenthal in the treatment of 1000 cases in Uganda by the daily intravenous injection of calcium chloride—a treatment, it is claimed, which constitutes a definite advance and is superior to all others previously attempted. Brown (88), also writing from Uganda, confirms these views. He has given us a valuable contribution to the etiology of tropical ulcer, its bacteriology, sex and

tribal incidence, and association with syphilis, yaws and parasite infection. He also considers that ulcer is related to faulty calcium metabolism, not perhaps so much to an absolute deficiency of calcium as to its dietary imbalance and imperfect absorption, the parathyroid gland being in some way associated. An important factor is the quality of dietary protein. The prevalence of ulcers among vegetarian tribes and their absence in meat-eating tribes such as the Masai (see under Kenya) strongly indicate that meat is the only satisfactory source of protein. In the Buganda Province, which Brown particularly studied, the main foodstuffs were maize, banana flour, beans (mutike), ground nuts, cassava (mohogo) and sweet potatoes.

Vitamin A deficiency in Teso.—Loewenthal (89) has further added to our knowledge of nutrition in Uganda by his enquiry into vitamin A deficiency among the population of Teso. In this district green food is very scarce during the dry season which lasts from mid-December until the end of March. The diet of the people is millet, maize meal, cassava and ground nuts, with green vegetables when available. Meat is rarely eaten, and eggs and milk only occasionally. Of 1112 individuals examined, both children and adults, 300 had symptoms of vitamin A deficiency, 277 having phrynoderma and 44 xerophthalmia. There were no signs of any other deficiency. It is pointed out that although the accepted signs of vitamin A deficiency, namely, xerophthalmia, keratomalacia and night blindness are the most noticeable, the prevalence of other symptoms such as neuritis, sore mouth, itching and skin infections, suggest that the deficiency does not concern vitamin A alone, but is multiple in nature. Vitamin C deficiency has been reported by the Medical Department (90) as occurring among children in various districts.

Zanzibar.

The state of native nutrition in Zanzibar has received special attention from the Medical Department, dietary studies being recorded in recent Annual Reports (91, 92, 93, 94, 95). The estimated chemical composition of the diets of five classes of the population has been reported upon by Smith and Smith (96). The diets were those of the Maungani, a poor class homogeneous country dwelling community, and of four distinct groups of town dwellers. The diets of the town groups cost (1) under Rs. 7, (2) from Rs. 7–8, (3) from Rs. 8–10, and (4) over Rs. 10 per head per month. The basis of all diets was rice and other grains, cassava, sweet potatoes, bananas, coconuts and varying

amounts of fish, meat, ghee, vegetables and sugar. The estimated intake of proximate dietary principles for the five groups was as follows :

Class.	Total Protein.	Animal Protein.	Fat.	Carbohydrate.	Calories.
	g.	g.	g.	g.	
Maungani .	51	11	77	480	2904
Town (1) .	60	13	37	460	2458
,, (2) .	89	16	69	614	3520
,, (3) .	74	20	106	560	3584
,, (4) .	103	32	109	746	4489

It is obvious that the bulk of the protein is obtained from vegetable sources. The diets of the poorer classes are reported to be deficient in vitamins A and B, since only small amounts of fresh vegetables and almost no animal fats are eaten.

A striking feature in Zanzibar is the inferiority of rural compared with town children (94). Among rural children only 35 per cent. of Africans and 43 per cent. of Arabs can be described as well nourished. Indian children have the poorest physique of all. Over 60 per cent. of children examined suffered from dental defects (91, 93). The 1933 epidemic of ulcers, so marked in Pemba, coincided with a dry year, food crop failures and poverty ; and in one district a noticeable increase in respiratory disease is ascribed to malnutrition and avitaminosis (94). In common with similar circumstances in other East African territories, vitamin deficiency is prevalent among prisoners in Zanzibar, and has necessitated revision of institutional dietary scales. The appearance of avitaminosis in subjects who have been in prison for less than six months is disquieting and suggests that the imperfect dietary of the poorer classes outside the gaol is primarily responsible, leaving insufficient time for the more adequate prison diet to counteract the susceptibility to vitamin deficiency already implanted in the subject (95).

II. PALESTINE, AND MEDITERRANEAN TERRITORIES.

Cyprus.

In the Annual Medical and Sanitary Report for 1934 (97), it is recorded that 17·9 per cent. of children examined had defective teeth. This might be taken as indicative of minor degrees of nutritional deficiency. No systematic research has been conducted in this territory.

Gibraltar.

Problems of a nutritional nature apparently do not arise to any special extent. Soup kitchens play an important part in maintaining the health of school children during the winter months. The usual meal consists of vegetable soup, containing meat and potatoes, and a thick slice of bread (98).

Palestine and Trans-Jordan.

In 1931 Kligler and his associates in the Department of Hygiene of the Hebrew University, Jerusalem, published an account of their enquiry into the diets of various sections of the urban and rural population of Palestine (99). The study embraced the Ashkenazic (European) and Oriental sections of urban Jewish communities, the Kwutza or Jewish rural agricultural groups, and both Arab peasant and Bedouin families. The Ashkenazics live on a better scale than the Orientals. They consume more meat, milk and butter than the Orientals, who eat more vegetables. The rural Jewish communities eat more than the two urban groups studied. The children's diet is much richer in fat than that of adults and has an excessive energy value and a faulty calcium/phosphorus ratio. As regards the two groups of Arabs, it was found that the semi-agricultural Bedouins consume more milk than the agricultural villagers (Fellahin) and use butter oil rather than olive oil, which, on the other hand, is freely consumed by the villagers. The Bedouins also eat more meat and less vegetables than the Fellahin. The high fat intake and relative excess of phosphorus in the diet of the villagers are regarded as unsatisfactory features. The authors' rat experiments lead to the conclusion that excessive fat consumption is definitely harmful in sub-tropical regions. As is the case in other countries, the economic status of the individual

is the factor which determines good or bad nutrition in Palestine. Seventy to eighty per cent. of the income is spent on food. In all groups examined the quantity and quality of the diets were found inferior during the winter months. It is of great importance, therefore, that the production, distribution, and storage of Palestinian foods be regulated against times of scarcity.

An illness resembling summer diarrhœa is common among infants in Palestine with the approach of hot dry winds. The condition is associated with nervous symptoms recalling vitamin B deficiency, and has been effectively treated by the administration of vitamin B_1 concentrate. It has been suggested by Grünfelder (100), who describes the disease, that hot weather increases the body's demands for vitamin B, infants on the borderline of deficiency most readily developing the symptoms.

The general health conditions of four Bedouin tribes in Trans-Jordan were carefully studied by MacLennan (101) of the Colonial Medical Service. The tribes examined were very poor, existing on a diet inadequate in both quantity and quality and often consisting exclusively of unleavened bread (khabs). Milk was available only to those possessing goats or camels ; meat was a luxury, and the only other supplementary foods were small quantities of grapes, figs, dates and melons eaten mostly by the richer families. MacLennan examined a total of 1030 persons. Of these only 164 were well nourished. Thirty-three per cent. were very poorly nourished and in many cases emaciated. The majority showed some degree of anæmia ; tuberculosis was frequent and ran a swifter and more acute course than in Europe. Cases of rickets and scurvy were almost negligible, while pellagra, beriberi, xerophthalmia and goitre were not observed.

III. CEYLON, MALAYA, AND EAST INDIAN TERRITORIES.

Ceylon.

Few, if any, more admirable nutritional studies have been carried out in the Colonial Empire than that by Nicholls (102) of the Colonial Medical Service relating to the diet and health of the poorer classes in Ceylon. The following notes are taken from the account of his survey. The staple cereal is rice. About half the Island's total consumption is home grown and is used in the country districts in the unpolished state. That used in towns and on estates is imported polished rice.

Millet is used in some areas. Green and black gram, yellow and chick peas are also used, but the legume most eaten is dâl (*Cajanus cajan*). Foods of animal origin are consumed by the poorer classes in only negligible amounts, except for fish in the coastal areas. Food consumption increases as purchasing power increases. Nicholls has provided informative data on the heights and weights of children from different social grades, comparing Ceylon figures with the averages for children in Great Britain. The Ceylon child appears to grow more rapidly during its earlier years, but only in the upper classes attains the same height as a British boy at 19 years. Vernacular school children closely resemble the Kikuyu (see under Kenya) in rate of growth. Birth weights of 1500 children born in a maternity home were recorded and revealed a difference of 1 lb. between those born in non-paying and those born in paying wards, the latter having approximately the same birth weight as average English children.

The diets of 16 labouring coolie families were studied in detail and compared with those of Javanese peasants, the conclusion being that an agricultural labourer belonging to the smaller races of the tropics requires only 2200 Calories per day. This conclusion is reached in spite of the demonstration that stature depends on social status. The most important source of calcium for the poorer classes is small fish, which are eaten whole except for the head. Pica, taking the form of earth eating, is common among children and pregnant women. The general and infant death-rates in Ceylon are high. Rickets is uncommon, but other deficiency diseases such as phrynoderma, sore mouth, blindness, anæmia and œdema are frequently seen. Phrynoderma, a vitamin A deficiency characterised by skin lesions, has been further described by Nicholls (103, 104) as occurring in Ceylon prisons, schools and mental asylums. The institutional diets in general use were seriously lacking in vitamins, especially vitamin A, and consisted mainly of rice, dried fish, very little meat and some vegetables according to seasonal availability.

Considerable information on Ceylon conditions is also available from recent Medical Department Reports. The subject of nutrition is being stressed in schools, and attention is being focussed on the eating of three proper meals a day as a health habit (105). The commonest defects seen among school children at routine medical examination are dental caries (24 per cent.), hookworm infestation (15 per cent.) and malnutrition (10 per cent.). It is reported that 10,000 children die annually from a skin condition, called " rathe," now known to be due

in part to vitamin C deficiency (106). There is also a considerable incidence of vitamin A deficiency among children in rural schools (107).

Malaya: Federated Malay States and Straits Settlements.

Two research centres which have made valuable contributions to our knowledge of nutritional conditions in Malaya are The King Edward VII College of Medicine, Singapore, and The Institute for Medical Research, Kuala Lumpur. Working at the former, Rosedale, Oliveiro and Morris (108, 109, 110, 111, 112) have compiled extensive data on the mineral and vitamin composition of tropical foods used in Malaya. They have specially examined the antiscorbutic properties of local citrus and other fruits and the vitamin A potency of earthnut, gingelly, coconut, red palm and olive oils. There is little danger of vitamin D deficiency among people with access to such abundance of sunlight as prevails in Malaya, and the use of some oil, such as red palm oil which is a good source of vitamin A, is recommended for culinary purposes.

Nutritional researches at the Institute for Medical Research at Kuala Lumpur have also been concerned with the vitamin content of locally used products including vitamin A in Malayan palm oil and vitamin B_1 in rice polishings (115). The latter studies have been undertaken in connection with prophylaxis against beriberi and arrangements have been made whereby an extract of rice polishings is distributed for use throughout the Federated and Unfederated States and Straits Settlements. In 1934 the number of deaths from beriberi in the Federated States was 340, compared with 254 in 1933 and 264 in 1932 (114). This increasing death-rate is coincident with a steady improvement in general prosperity and corroborates previous observations (113) that the incidence of beriberi in Malaya is directly related to the degree of prosperity of the community, the explanation being that higher purchasing power enables poorer classes to buy the more expensive highly polished rice in preference to the unpolished, vitamin B containing, variety.

Dental caries in Malaya has been studied by Mummery (116), who found the highest incidence among Chinese immigrants whose diet consists largely of tinned, preserved or mummified foods. The severity of caries in children varied in all races in direct ratio to the child's proximity to a town or village. In the country districts where more vegetables are eaten, the dental conditions were comparatively good.

It is presumed that the more sophisticated and less wholesome foods obtainable in the towns and the extensive hawking of sugary cakes and sweetmeats in schools are the factors primarily responsible for the extent of dental decay seen among urban children.

Some observations on vitamin A starvation among immigrant Indians in Malaya have been made by Field (117). He quotes evidence that the incidence of xerophthalmia and night blindness is much higher among them than in Malayans or Chinese. The factor of safety in the Malay diet appears to be the fresh natural produce grown by the peasant on his own small holding. The general disease resistance was also found to be lower in Indians than in Malayans and Chinese. For example, during the 1918 influenza pandemic the mortality rate among Indians in Perak increased enormously, while that of the other two races showed only a small rise.

Statistics kept at a central group hospital serving 17 rubber plantations in Western Malaya have been made available by Reed (118), and show a high maternal mortality rate (29·6 per 1000) largely occasioned by intercurrent disease, including malaria. Neonatal deaths which comprised 56·8 per cent. of the infant mortality were ascribed chiefly to malnutrition of the mother. The average weight of newly born infants was only 5·3 lb.

Malaya : Unfederated States (Johore, Kedah and Perlis, Kelantan, Trengganu.)

Landor and Pallister (119) and Garlick (120) describe a disease frequent in prisons at Johore and Singapore which in some ways resembles pellagra and is characterised by an eczematous condition of the scrotum and corners of the mouth. In its later stages the disease is often accompanied by nervous symptoms affecting the eyesight and gait. It is considered that a food deficiency of the B vitamin group is responsible inasmuch as marked improvement follows the administration of marmite or fresh yeast. Chinese, Malay and Indian prisoners were affected alike ; but not those prisoners who were engaged in cooking or other kitchen work. The prison diets consisted chiefly of rice, bread and vegetables, with very little meat, and were poor in foods containing the vitamin B complex.

Medical Reports indicate that a high percentage of children in Johore suffer from dental defects. Of 2058 school pupils examined in 1934, over 60 per cent. required treatment (121). Precisely similar

statistics are available from Kedah and Perlis (122) where dental caries was found in 61·4 per cent. of school children.

The occurrence of beriberi is frequently referred to in Reports from Kedah and Perlis (123), Kelantan (124) and Trengganu (125). In general the Malay and Indian population are freer from the disease than are the Chinese immigrants. This is because the Chinese are accustomed to buy imported polished rice, whereas the staple food of the other two peoples is parboiled unpolished rice grown locally. Cases of goitre are reported from Trengganu (125) where varying degrees of thyroid enlargement are common, especially among pregnant women and at puberty.

Brunei, North Borneo.

There is little to report from the island of Borneo. Nutritional conditions are similar to those on the Malay peninsula. Statistics on deficiency diseases are to be found in the Annual Reports from Medical Departments, and, in Brunei, for instance, the custom of feeding parturient women solely on white rice contributes to a high incidence of beriberi and consequent high infantile mortality (126).

Quite recently a number of samples of edible earths have been sent from North Borneo to the Rowett Institute, Aberdeen, for analysis. In a private communication the Director of Agriculture at Sandakan states that these earths are eaten mostly in times of famine, in some cases being added to the boiling water in which rice is cooked. In regard to another sample, eaten as a rule only by women and children, the practice is to dry the substance to the consistency of rather thick putty and eat it in this form unmixed with other food. The predilection for these edible earths is doubtless due to some deficiency in the ordinary diet as yet unelucidated.

Hong-Kong.

Data in the Medical Reports from Hong-Kong are interesting as showing that, although polished rice is the staple food in this part of China, beriberi is not epidemic. The death-rate per 1000 from this disease was, 0·59 in 1932, 0·56 in 1933 and 0·47 in 1934 (127, 128, 129). Sydenham (130) records that, during the years 1926–1930, beriberi was diagnosed in only 10 pregnant women out of 1600 who attended for delivery at the Maternity Hospital. Beriberi is rarely seen among women in Hong-Kong except during pregnancy when the extra demands imposed on resistance may precipitate an attack.

IV. WEST INDIES AND NEIGHBOURING TERRITORIES.

Bahamas.

No nutritional research is in progress, but the medical authorities report (131) that the diet of the poorer classes is deficient in first-class protein, fat and minerals. Pellagra and nutritional œdema are common, the number of cases showing a notable decrease in the Islands during years when hurricanes have not devastated the fruit crops (132).

Barbados.

(See under Trinidad.)

British Guiana.

The high incidence of megalocytic anæmia among East Indians in British Guiana is a problem of grave social and economic importance. The disease, which has been fully described by Giglioli (133), affects both sexes, but is most frequent in women, especially during and following pregnancy, and is the main cause of maternal and neonatal mortality, prematurity and congenital debility. In the past the condition has been confused with ankylostomiasis, a heavy infection of which may give rise to an anæmia of megalocytic type ; but Giglioli has found no connection between ankylostome infection and the anæmia he describes, which more nearly resembles the macrocytic anæmia of pregnancy common in temperate countries. The disease can be cured by the administration of liver or liver extract, or by marmite (yeast extract) or by a combination of both.

Beriberi has been known to occur in British Guiana, and notes are given by the Surgeon-General in his Report for 1934 (134) of an outbreak which occurred among the officers and men of the British Guiana-Brazil Boundary Commission.

British Honduras.

The native dietary consists mainly of tea, bread, rice, beans and salt pork. In northern districts maize is the staple food. There is much evidence that the diet lacks balance and is vitamin deficient. Dental caries and constipation are general and insufficient advantage is taken of the fresh foods available (135). The Medical Department

is alive to the situation and is endeavouring to ameliorate conditions by practical and educational work in Maternity and Child Welfare Centres.

Jamaica : Turks and Caicos Islands.

In Grand Turk and Salt Cay many of the inhabitants suffer from a lack of vitamins due to a dietary deficiency of green vegetables and fruit. Meat and fish are generally available, but in the case of the labouring and poorer classes the diet is deficient in both quantity and quality, consisting of little more than rice or grits, white flour and sugar, with no green vegetables or fruit. A considerable amount of the ill-health occurring in the Dependency is directly attributable to this lack of adequate diet. Pellagra is prevalent, but compared with previous years there was a marked decrease in the number of cases occurring during 1935. The above facts are taken from recent Annual Reports published by the Medical Department of the Islands (136, 137, 138).

Trinidad and Tobago.

Seagar (139) has given some interesting facts with regard to food consumption by industrial workers in Trinidad. They were gathered from sugar and cacao estates, on both of which East Indians and West Indians are employed. Rice and flour are the two main sources of carbohydrate, but tubers such as potatoes and root crops also contribute. The East Indians were found to eat more than West Indians, and those employed on the sugar estates more than those on cacao estates. Some figures are given supporting the contention that the best health goes with the larger diet, and the claim is put forward that labour efficiency might be increased by closer attention to dietetics. Clark, who has done much important work in the Colonies (see under Nigeria) on the toxic principles which occur in native foods, spent some time in Trinidad examining the relationship between diet and the occurrence of nephritis (140). Nephritis of all types is unusually prevalent in Trinidad where tannia and other aroid tubers are among the principal articles of diet. Clark has produced a very acute nephritis in rats by feeding them with raw tannia, and has demonstrated very clearly the extent to which tannia may exert toxic effects. It is possible that malnutrition and malaria, both common in Trinidad, may be additional factors in the production of nephritis. The malarial factor, however, may probably be ruled out, because, in the Barbados,

where the economic and dietetic conditions are similar to those in Trinidad, but where malaria was unknown till 1927, nephritis has always been exceedingly common. Further, the introduction of malaria into the Barbados does not appear to have altered the nephritis incidence.

Windward Islands: Grenada, St. Lucia.

No food deficiency was reported in the Colony of Grenada during 1933 (141). Rickets, pellagra, beriberi and scurvy are unknown in the Island, the vitamin content of the dietary evidently being adequate. On the other hand, the Medical Officers of four different districts in St. Lucia stress the poverty and unsuitability of the diet as a general cause of much ill-health and lowered vitality among the natives (142).

V. ISLANDS OF THE WESTERN PACIFIC.

Fiji.

Under the heading of "Food Diseases" cases of epidemic dropsy are recorded in recent reports from the Medical Department. Sixty-seven cases were investigated in 1932 (143) and 54 in 1933 (144). Œdema of the lower extremities, anæmia, digestive upset and diarrhœa are characteristic of all cases. Though by no means conclusive, there is evidence that the disease is in some way associated with mustard oil (143). In 3 cases which occurred at the Public Lunatic Asylum, œdema is stated to have diminished seven days after bread was substituted for rice, and to have disappeared a week later. Some of the local rice crops gave evidence of having been harvested in a wet condition which may have been a contributing factor (144). (For analogous findings, see under Sierra Leone, Ref. 65.) Tropical ulcer is also seen in Fiji and has been described by Clunie and Eva (145). The disease, which mainly affects the exposed parts of the limbs, appears only among natives or East Indians at schools and other institutions, or in road gangs receiving food which approaches European standards. The etiology is not definitely known, but a deficient or unbalanced diet appears to play a part. A return to native foods, fruits and fresh coconut milk drunk from the nut, was the most successful treatment.

Gilbert and Ellice Islands.

The native diet consists almost entirely of fish, coconut, pandanus fruit, and "babai," a species of wild taro (147). It is said to be ill balanced, containing excessive carbohydrate and fat, but lacking protein and vitamins. Writing on tuberculosis problems, the Senior Medical Officer suggests that faulty diet is a factor contributing to the high incidence of the disease found among the Gilbertese (146).

Solomon Islands.

Conditions in the British Solomon Islands Protectorate are apparently not dissimilar to those in the neighbouring Gilbert Islands mentioned in the previous paragraph. The native dietary is reported to be poor in the elements which afford good resistance to tuberculosis. It is mainly carbohydrate, of low nutritional value and deficient in protein, fat and vitamins (148).

VI. ISLANDS OF THE SOUTH ATLANTIC.

Falkland Islands.

Mutton, tea and bread form the staple diet of the Falkland Islanders, supplies of fruit being irregular and costly. The three most recent Reports from the Medical Department (149, 150, 151) all emphasise that in the lack of dietary balance and variety lies the answer to the problem of the prevailing high incidence of dental caries, appendicitis and constipation. The consumption of more green vegetables is recommended in order to decrease the prevalence of these conditions.

St. Helena.

St. Helena provides for the existence of a population of about 4,000. Until it was handed over to the Crown, the Island suffered from four centuries of faulty agricultural administration, no consistent encouragement having been given to settlers to preserve the natural resources or improve agricultural methods. The general deterioration of lands and rapid decline in fertility has gone hand in hand with an increase in the nutrition problems confronting the inhabitants, many of whom live at a deplorably low standard. The Medical Department is investigating the state of human nutrition in the Island, especially in connection with the incidence of beriberi. (Private Communication.)

Tristan Da Cunha.

A very interesting account has recently been given by Owen (152) of the history, habits, customs and mode of living of the inhabitants of this lonely island. At the time he wrote the total population was 169, of which 93 were males and 76 females. A visit from a ship about once yearly is the only communication the islanders have with the outside world. The diet consists chiefly of potatoes, milk and fish; very little meat is eaten. Penguin and albatross eggs are to be had in abundance and vegetables are plentiful, especially cabbage, turnips and pumpkins. The general health of the community is excellent, and the children are strong and well developed. The people live long, infectious diseases are unknown, and "colds" are rare, an epidemic occurring only after the visit of a ship. No condition resembling tuberculosis or venereal disease is known. The teeth of the young men and women are characteristically regular in formation, are very clean, and show no signs of decay. During a visit early in 1932, Sampson (153) made a careful examination of the teeth of the islanders to determine to what extent caries was present. He found caries in only 1·84 per cent. of all the teeth examined, and that 83·3 per cent. of mouths were dentally perfect. Most of the teeth were yellow, but strong, well calcified and not hypoplastic. Toothbrushes were unknown on the island. These almost perfect conditions are attributed to the type of diet eaten, especially to the fact that cereals and sugar are rarely used, only being obtainable on the infrequent occasions when ships visit the island. The children were invariably breast-fed, and in the age groups 1–5 and 6–13 years their mouths were perfect.

CONCLUSION.

The first impression left on the mind of the reader of the foregoing must be one of concern at the widespread nature of the nutritional problem in the Colonies. Diseases resulting from malnutrition are not confined to one or two areas but, though they may vary in degree, prevail almost everywhere among tribal races. We find them as far West as the Bahamas, Honduras and Fiji, and as far East as Ceylon, Malaya and Borneo. Secondly, one is impressed by the general similarity of the deficiency symptoms found in widely separate parts of the Empire. Leaving aside the question of the beriberi characteristic of rice eaters and the pellagra associated with maize eating, we

find diseases such as nutritional œdema, for example, occurring in the African Colonies of Kenya, Northern Rhodesia, Sierra Leone and Uganda ; we find it in Ceylon in the East and in the Bahamas and Fiji in the far West. Tropical ulcer, too, is general in its distribution, being found in almost every part of Africa. Another arresting feature is the ubiquity with which deficiency diseases are met with in native prisons, hospitals and mental homes. Despite the care taken to improve institutional dietaries, outbreaks of disease of nutritional origin continue to crop up with perplexing frequency.

In general, it may be said that the native food problem is not so much one of quantity as one of quality. Excess of carbohydrate, deficiency of fat and of first class protein and uncertain supplies of green vegetables are all too common. Such dietary imbalance involves both vitamin and mineral deficiency which is directly responsible for the prevalence of much night blindness, xerophthalmia, keratomalacia, tropical ulcer and anæmia, and indirectly for a high incidence of tuberculosis, pneumonia and other pulmonary conditions resulting from a generally lowered resistance to infectious diseases.

Much has been done, but much remains to do. " Probably the outstanding urgent problem so far as the native races are concerned is to make it possible for them to have a continuous supply of sufficient and well-balanced food, and the next most important problem is housing. It may therefore be said without fear of serious contradiction that the first task before the administrations of predominantly native territories is the raising of the economic status of the population. In an under-nourished population, especially if it is subjected to periods of famine or semi-famine, the mere treatment of disease, no matter how effectively and widely carried out, will achieve but negligible results." These are the conclusions of the International Conference of Representatives of the Health Services of Certain African Territories and British India who considered the nutrition question at their meetings at Cape Town in 1932 (173).

Effective progress towards improved nutrition is impossible without establishing a close *nexus* of interest between those concerned with economic and agricultural planning and those responsible for public health. Fortunate it is that the authorities entrusted with the welfare of native races realise this, for it is only by vigorous, enlightened and well-directed co-operation between Departments of Agriculture, Economics, Medicine and Education that a sound food policy can be formulated and applied in the best interests of native peoples.

APPENDIX.

Union of South Africa.

The following paragraphs, summarising what has been done in respect of nutritional research in South Africa, are included in view of the close similarity of Union conditions to those in adjacent Colonial territory and in more northerly parts of Africa.

Broadly speaking, research has centred round three main problems, namely, the requirements of various South African native races, the problem of the poor-white population, and the dietetics of natives employed on the Witwatersrand gold mines. Prominence has been given to South African work by the valuable publications of Fox and his associates at the South African Institute of Medical Research at Johannesburg, by the Report of the Carnegie Commission on the Poor White Problem, and, by the papers of Orenstein, Chief Medical Officer of the Central Mining-Rand Mines Group.

Diet of native South African races.—The diet of large sections of the South African population consists chiefly of maize in the form of mealie meal and, in general, suffers from a deficiency of good protein, minerals and vitamins. The margin of safety for vitamin B_2 is especially narrow, as is shown by the periodic outbreaks of pellagra in Bantus and among the natives of Zululand and Transkei, who are consistently in a sub-pellagrous state. Scurvy is not uncommon in native territories, and, like pellagra, is precipitated when drought conditions are severe or when men leave their Reserves to undertake hard work as, for example, in the mines. The main mineral deficiency seems to be one of calcium, manifesting itself, however, in ways other than rickets, osteoporosis and caries which are comparatively rarely seen in rural communities. The infant mortality and general death-rates are high, and a large proportion of young adult males are rejected as unfit for work in the mines. Of particular interest are the anthropological data contained in the report of the South African Tuberculosis Research Committee (158) from which it appears that the average native presenting himself for mine work is 5 feet 5 inches in height, weighs only about 129 lb., and has a chest measurement of 34 inches. There is great need for an all round dietary improvement in South Africa, and a greater use of milk, meat, fish, and soya bean is recommended (154, 155, 156, 157, 158).

Through contact with European culture the urban native is tending to discard his tribal food habits and imitate the more advanced standards of his new environment (159). Unfortunately these are not all that might be desired, for, as Oranje and his co-workers have shown (160), natives employed with Europeans on farms or as labourers in towns or in mines show a much higher incidence of dental caries than those living according to primitive custom. This damage done to teeth is ascribed to increased income enabling the native to obtain sugary European delicacies and other " sophisticated " foods.

Goitre is not a problem of any great magnitude in South Africa except in one small district, namely, the Langkloof Valley which has been specially studied by Blom (161) and by Buttner (162). During a medical survey of the schools in the Langkloof district a few years ago it was found that from 80–90 per cent. of the children had goitres. The food eaten is almost all produced locally, consisting chiefly of cereals and meat ; but chemical analyses established no fixed relationship between the iodine content of these local foodstuffs and the incidence of goitre. The soils were not proved to be grossly deficient in iodine but, on the other hand, had a specially high calcium and phosphorus content, a circumstance which, it is suggested, may increase the metabolic demands for iodine and hence bring about a relative deficiency of that element.

As an essential preliminary on which to base recommendations for the improvement of native dietaries, Fox has determined the chemical composition of a large number of South African foodstuffs not only in respect of their mineral content but also as regards their antiscorbutic value (154, 163). On account of its high protein content (25 per cent. of dry weight), its richness in calcium and iron and its value as a source of vitamins A and C, Fox and Wilson (164) recommended the use of lucerne as a human food, especially as part of the ration for native mine labourers on the Rand.

The poor-white problem in South Africa.—The social-economic conditions existing among a considerable section of the South African white population are unsatisfactory and react unfavourably on their health. The causes of this are not exactly known, but are in large measure related to inadequate nutrition consequent on poverty. The problem was studied by a Special Commission (165, 166) who, using physical measurements of some 1700 children of different ages as a guide to their nutritional state, came to the conclusion that most of the unfitness seen was due to malnutrition originating from poverty.

Adolescents, unemployed owing to financial stringency and threatening to become a danger in permanently swelling the ranks of poor whites, were organised into special service battalions where they were carefully fed, exercised and disciplined. Physical measurements at enrolment and at various periods over intervals of several months showed a steady betterment in the condition of the boys according to the time they remained in the battalions. It is held that the physical inferiority of the poor white section in South Africa is not hereditary but environmental, primarily dietetic, and hence controllable and capable of improvement.

Nutrition of natives employed on gold mines.—Approximately 300,000 native labourers are employed in the gold mines of the Central Mining-Rand Mines Group. The feeding of this large number of men from common kitchens is one of the largest undertakings of the kind in the world. The diet consists of mealie meal, bread, having not less than 64 per cent. of wheat flour, beans, meat, nuts and fresh vegetables. The minimum scale provides a total Calorie value of 4400. Practical experience has proved the diet to be adequate in all respects with the possible exception of vitamin A, to the alleged deficiency of which some observers ascribe the prevailing liability to infection with tuberculosis, one of the plagues of South African native races (158, 167). However, despite no change in the vitamin A content of the diet between 1916 and 1934, the incidence of tuberculosis in the mines dropped in that period from 12 to under 3 per 1000. It is also noteworthy that the mortality from disease in general has dropped in twenty years from over 30 per 1000 to under 9 per 1000. Proper feeding is essential to make good the enormous losses of energy experienced by some of the mine workers. Careful weight records made by Orenstein's department (167) show that drillers may lose $1\frac{1}{2}$ lb., shovellers $3–3\frac{1}{2}$ lb. and tramming men as much as 4–5 lb. in weight daily.

Orenstein (168) and Fox (169, 170) also investigated whether there was any correlation between the vitamin A content of the livers of Bantu mine labourers and their resistance to pneumonia. The range of vitamin A values obtained, even from livers of healthy individuals, was wide, and gave evidence that the majority, whether dying from accident or pneumonia, had a fair storage of vitamin A. The values from the pneumonia cases were on the whole lower, but it is considered unlikely that the vitamin reserves were rapidly exhausted during the course of the disease ; more probably initially low reserves of the vitamin may have conduced to it. As has already been mentioned, the use

of lucerne which is naturally rich in vitamins A and C is specially recommended for inclusion in the diet of native mine labourers (164). This practice has been adopted on several mines as a safeguard against the "subscorbutic" state which is believed to exist among many natives and to have an unfavourable influence on the course of infectious disease and the healing of wounds (171).

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